

WATER POSSIBILITIES FROM THE
GLACIAL DRIFT OF
PUTNAM COUNTY

BY

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Water Resources Report 4

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MISSOURI GEOLOGICAL SURVEY AND WATER RESOURCES ROLLA, MO.

William C. Hayes, State Geologist and Director

WATER POSSIBILITIES FROM THE GLACIAL DRIFT OF PUTNAM COUNTY

A special study of groundwater by the Missouri Geological Survey and Water Resources was made possible at the 1955 session of the Missouri Legislature. With the approval of the Governor, money was appropriated from the Missouri Post War Surplus Reserve Fund.

Since nearly two-thirds of the counties located north of the Missouri River are deficient in water supplies, much of the effort of this special study is being directed toward the problems of this area.

It is hoped that a program of test drilling will locate new reserves of groundwater. Potential areas are being tested so that additional supplies will be available for irrigation, municipal, industrial and domestic needs.

The most favorable areas are in the channels and valleys of pre-glacial and inter-glacial streams where the sand and gravel beds of glacial drift are thick. Since these buried valleys do not conform to present day drainage patterns, a systematic program of test drilling is a principal means of locating the channels and mapping their extent. Such glacial deposits have proved to be excellent sources of groundwater.

QUALITY OF WATER FROM ROCK WELLS

The water from the consolidated rock formations which underlie Putnam County is, for the most part, highly mineralized. The following are analyses from two oil tests, B through I being from the same well but from progressively greater depths.

CONSTITUENTS	IN PARTS PER MILLION				
	A	B	C	D	E
Turbidity		turbid	turbid	turbid	turbid
Color		none	none	none	none
Alkalinity (CaCO ₃)	485.0	645.7	359.2		464.6
Carbonate (CO ₃)	0.0	15.2	11.1		34.6
Bicarbonate (HCO ₃)		771.9	427.4		531.5
Silica (SiO ₂)	12.0	6.0	28.8		7.6
Oxides (Al ₂ O ₃ , Fe ₂ O ₃ , TiO ₂ , etc.)	4.0	4.80	1.60		4.0
Calcium (Ca)	88.96	8.0	15.2		6.5
Magnesium (Mg)	56.78	7.8	48.7		23.3
Sodium (Na) & Potassium (K) as Na	595.7	1262.8	1243.1		1231.3
Sulfate (SO ₄)	853.49	197.9	587.0	295.7	343.4
Chloride (Cl)	346.0	1414.6	1414.6	1432.6	1416.8
Total Dissolved Solids	6691.0	3694.0	3718.0	3284.0	3347.0
Total Hardness	455.69	52.0	237.7		111.8
Percent of Alkalies	74	98	92		96

CONSTITUENTS	IN PARTS PER MILLION			
	F	G	H	I
Turbidity	turbid	turbid	turbid	turbid
Color	none	none	none	none
Alkalinity (CaCO ₃)	340.1	312.4	247.8	258.2
Carbonate (CO ₃)	13.8	13.8	6.9	0.0
Bicarbonate (HCO ₃)	400.7	367.0	295.3	314.9
Silica (SiO ₂)	7.6	7.2	11.6	7.2
Oxides (Al ₂ O ₃ , Fe ₂ O ₃ , TiO ₂ , etc.)	2.40	1.60	2.40	1.60
Calcium (Ca)	7.3	73.2	51.5	158.8
Magnesium (Mg)	25.9	66.6	70.8	59.2
Sodium (Na) & Potassium (K) as Na	1247.1	971.7	961.9	875.3
Sulfate (SO ₄)	722.6	936.6	913.7	1013.1
Chloride (Cl)	1333.4	879.7	879.7	851.9
Total Dissolved Solids	3269.0	3089.0	2950.0	3124.0
Total Hardness	124.4	456.1	419.0	639.7
Percent of Alkalies	95	82	83	74

A. Owner: Dan McLaughlin. (Harvey Johnson farm) NE $\frac{1}{4}$ NW $\frac{1}{4}$ NW $\frac{1}{4}$, sec. 13, T. 65N., R. 21W., total depth 1792 feet. This oil test penetrated glacial drift and the formations of Pennsylvanian and Mississippian Systems and bottomed in the Ordovician System. Sampled at a depth of 760-770 from the Spergen-Warsaw formations of the Mississippian System. Analyzed February 28, 1946 by H. Collier.

B. Owner: R. W. Clovis - C. F. Dittman, etal. (J.W. Huston farm). NE $\frac{1}{4}$ SW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 26, T. 65N., R. 19W. Oil test drilled to a depth of 1779 feet. Sample of water from Warsaw formation, Mississippian System at a depth of 660 feet. Analyzed August 18, 1939 by R. T. Rolufs.

C. As "B". Sampled at 825 feet, Keokuk-Burlington formation, Mississippian System.

D. As "B". Sampled at 1116 feet, Devonian System, analyzed August 10, 1939 by R. T. Rolufs.

E. As "B". Sampled at 1282 feet, Devonian System. Analyzed September 13, 1939 by R. T. Rolufs.

F. As "B". Sampled at 1364 feet, Devonian and Kimmswick contact. Analyzed September 22, 1939 by R. T. Rolufs.

G. As "B". Sampled at 1507 feet, Lower Kimmswick formation, Ordovician System. Analyzed September 13, 1939 by R. T. Rolufs.

H. As "B". Sampled at 1680 feet, Everton-St. Peter (undifferentiated) formation, Ordovician System. Analyzed September 22, 1939 by R. T. Rolufs.

I. As "B". Sampled at 1779 feet (TD), Jefferson City formation; Ordovician System. Analyzed September 22, 1939.

Referring to Plate 1, it will be noted that a large area of Putnam County is unfavorably located to obtain water from the glacial drift. Wells drilled into the consolidated rock to moderate depths may possibly obtain limited yields of water of marginal quality. Only very limited data are available, but as more rock wells are drilled it may be possible to outline definite potential areas where shallow rock wells may be obtained.

QUANTITY OF WATER FROM STREAMS

The streams of Putnam County are for the most part intermittent in their flow. Though the quality of the water is usually satisfactory, the undependable flow makes them unsuitable for irrigation or for municipal use. No analyses are available.

The following are stream flow data from: Bolon, Harry C., Surface

Waters of Missouri: Missouri Geological Survey and Water Resources, 2d ser.
vol. 34. pp 368 and 380, 1952.

Locust Creek near Milan, Sullivan County

Location. - Chain gage in SW $\frac{1}{4}$ sec. 8, T. 62N., R. 20W., at bridge in State Highway 6, 3 $\frac{1}{2}$ miles southwest of Milan.

Drainage area. - 225 square miles.

Records available. - July 1921 to September 1933 (discontinued).

Average discharge. - 12 years, 152 second-feet*.

Extremes. - 1921-33: Maximum discharge, 3,880 second-feet November 18, 1928 (gage height 20.07 feet); minimum, 0.1 second-foot August 8, 1930.

Revisions. - Revised figures of discharge for the water year 1925, superseding those published in "Water Resources of Missouri, 1857-1926", Vol. XX, Second Series, are given herein.

Chariton River at Novinger, Adair County

Location. - Water-stage recorder and wire-weight gage, lat. 40° 14'05", long. 92° 41'00", in SE $\frac{1}{4}$ NW $\frac{1}{4}$ sec. 27, T. 63N., R. 16W., at bridge on State Highway 6, 1,000 feet downstream from Chicago, Burlington and Quincy Railroad bridge, 0.8 mile east of Novinger, and 2 miles upstream from Spring Creek. Datum of gage is 737.65 feet above mean sea level, datum of 1929. Prior to December 30, 1939, wire-weight gage daily at same site and datum.

Drainage area. - 1,370 square miles.

Records available. - January 1931 to September 1949.

Average discharge. - 18 years, 757 second-feet.

Extremes. - 1931-49: Maximum discharge, 22,900 second-feet June 7, 13, 1947 (gage height, 28.50 feet): Minimum, 0.1 second-foot August 31, September 1, 1936. Maximum stage known, 28.6 feet in June 1917.

Remarks. - Records, in general, are fair except those for periods of ice effect, which are poor. Wire-weight gage read daily, and used for periods of faulty recorder operation.

Revisions. - Revised figures of discharge for the water year 1939, superseding those published in "Surface Waters of Missouri; 1927-1939", Vol. XXVI, Second Series, are given herein.

*One second-foot equals 448.83 gallons per minute.

QUALITY OF WATER FROM GLACIAL DRIFT

In general the water from the glacial drift is high in total iron, total dissolved solids, and sulfates. The iron content in the water may cause staining of plumbing fixtures and laundry; however, relatively inexpensive water treatment for the iron will prevent this staining. For most types of irrigation, total dissolved solids should not exceed 2,000 parts per million and total alkalies should not exceed 75 percent. Most

people cannot tolerate water for drinking purposes which contains more than 1,500 parts per million of chloride, or 2,000 parts per million sulfate. Water with 300 parts per million of chloride tastes salty to some people. Sulfates in excess of 500 parts per million may have a laxative effect when first used for drinking.

The following are analyses from four wells developed in glacial drift:

CONSTITUENTS	IN PARTS PER MILLION				
	1	2	3	4	5
Turbidity	turbid	6	turbid	turbid	80
Odor	none	none	none	none	none
pH		7.5			7.7
Alkalinity (CaCO ₃)	393.5	420.5	193.8	251.4	247.0
Phenolphthalein		0.0			0.0
Methyl Orange		420.5			247.0
Carbonate (CO ₃)	0.0	0.0	0.0	0.0	0.0
Bicarbonate (HCO ₃)	479.9	513.0	236.5	306.6	301.3
Silica (SiO ₂)	14.0	13.3	6.0	10.8	9.3
Oxides (Al ₂ O ₃ , Fe ₂ O ₃ , TiO ₂ , etc.)	0.11*	1.0	0.0*	0.0*	1.7
Calcium (Ca)	182.9	135.6	55.2	101.8	103.5
Magnesium (Mg)	55.8	42.8	13.7	35.3	37.3
Sodium (Na) & Potassium (K) as Na	112.2	116.1	17.5	292.4	311.6
Total Manganese (Mn)		0.00			0.05
Total Iron (Fe)	4.20	0.82	4.60	13.07	13.12
Dissolved Iron	0.20	0.08	0.30	0.07	0.18
Precipitated Iron	4.00	0.74	4.30	13.00	12.94
Sulfate (SO ₄)	502.6	291.0	23.2	770.5	736.6
Chloride (Cl)	20.7	16.8	6.8	26.2	25.3
Nitrate (NO ₃)	17.03	2.2	13.83	1.47	5.8
Fluoride (F)		0.3			1.0
Total Suspended Matter	30.8	0.	17.0	114.4	41.
Total Dissolved Solids	1315.0	933.	316.0	1432.0	1449.
Total Hardness	686.0	514.7	194.2	399.2	412.0
Carbonate Hardness	393.5	420.5	193.8	251.4	247.0
Non-Carbonate Hardness		94.2			165.0
Percent of Alkalies	26	33	16	61	62

* Oxides (Al₂O₃)

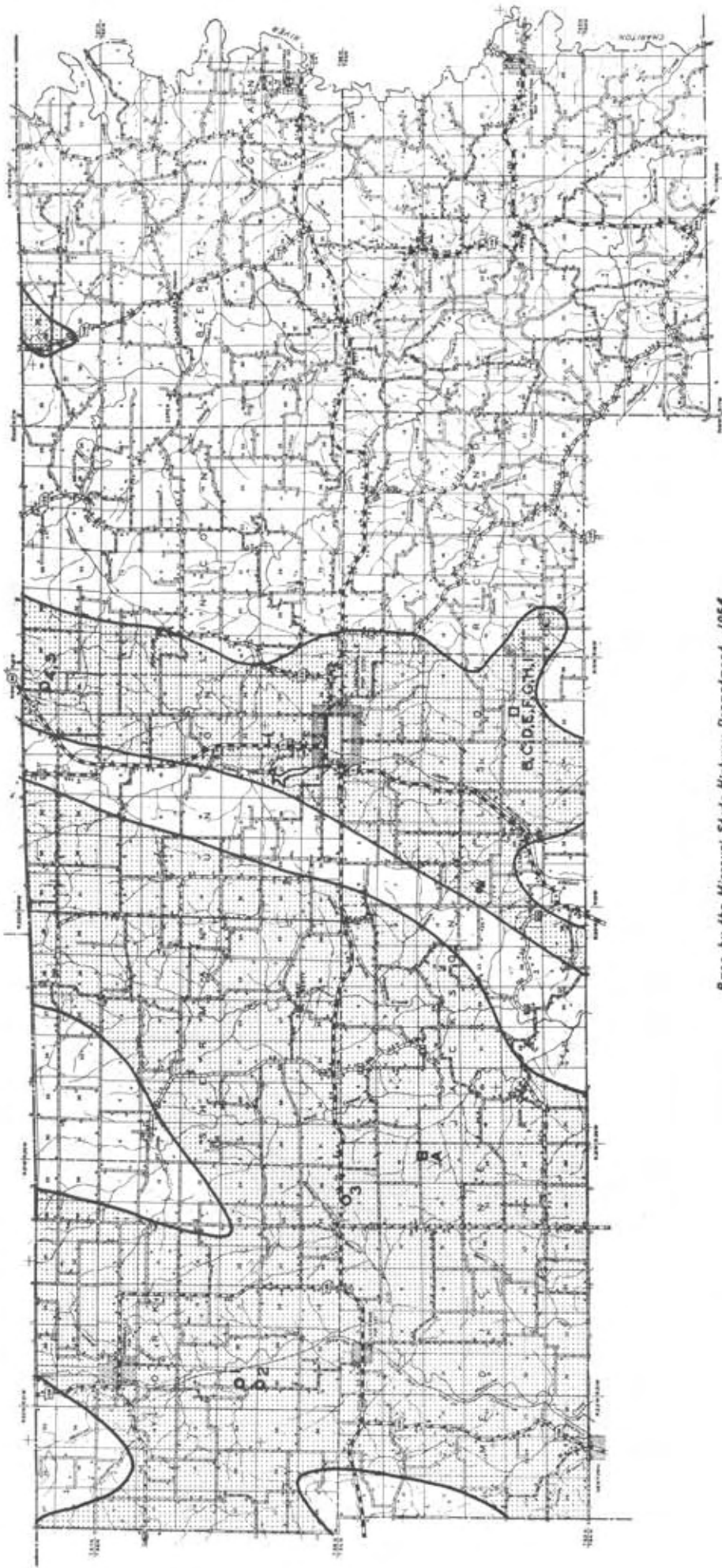
1. Owner: H. D. Pauley, NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 19, T. 66N., R. 21W., total depth 180 feet. Analyzed May 29, 1935 by R. T. Roulfs.

2. Owner: Walter Ellis, NW $\frac{1}{4}$ NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 30, T. 66N., R. 21W., total depth 150 feet, static water level 40 feet. Collected March 23, 1956. Temperature of the water 51° F. Analyst: M. E. Phillips.
3. Owner: Frank Collins, NW $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 2, T. 65N., R. 21W., total depth 26 feet. Analyzed May 29, 1935 by R. T. Rolufs.
4. Owner: Sid Morrow, NW $\frac{1}{4}$ SE $\frac{1}{4}$ sec. 25, T. 67N., R. 19W., total depth 227 feet. Analyzed May 29, 1935 by R. T. Rolufs.
5. Owner: As number 4. Temperature of water 47°F. Collected March 15, 1956. Analyst: M. E. Phillips.

QUANTITY OF WATER FROM GLACIAL DRIFT




DOMESTIC WELLS - Included in this category are wells developed for household or general farm use. Yields required from domestic wells vary but seldom exceed 15 gallons per minute. In some parts of Putnam County, the glacial drift cover is relatively thin or lacking. In such areas, the possibility of developing wells is limited. Plate 1 shows the area most favorable for the development of domestic wells. Plate 3 is a contour map showing the elevation of bedrock above sea level. To determine probable drilling depths, the elevation of the bedrock should be subtracted from the surface elevation for each specific site. Plate 3 also shows the locations of the test holes and the thickness of the glacial drift encountered.

IRRIGATION WELLS - Included in this category are all high yield wells whether used by cities, by industries, or for irrigation. Plate 2 shows the area most favorable for the development of irrigation wells. The total thickness of clean sand and gravel is not less than one hundred feet within this area, and is as thick as two hundred feet in limited areas. Shown also are the locations of nine test wells which flowed. With proper development it is anticipated that yields of 200-1,000 gallons per minute



Base by the Missouri State Highway Department, 1954

LEGEND

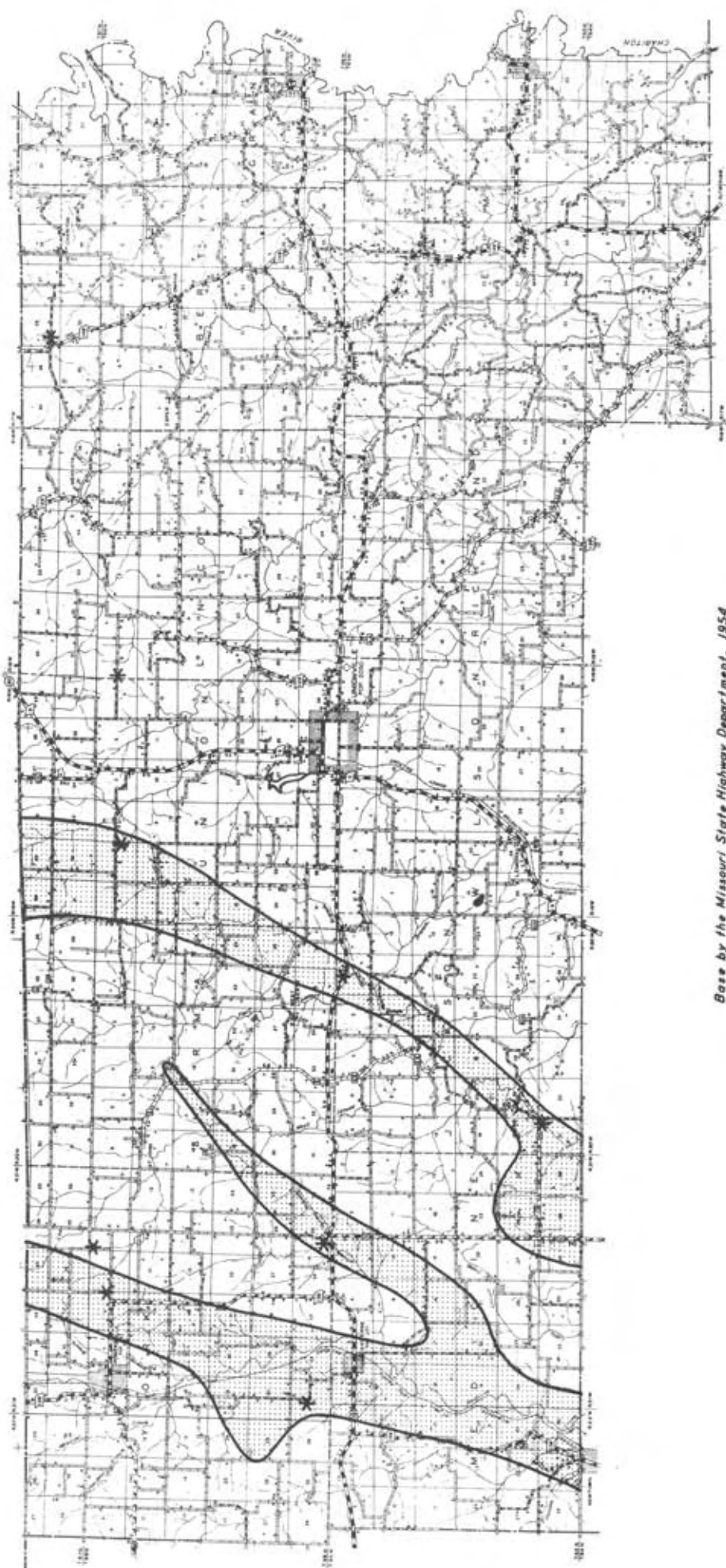
-  Area most favorable
-  Location of wells in drift from which water was analyzed
-  Water sample analyzed from a "rock" well

MAP OF PUTNAM COUNTY SHOWING AREA MOST FAVORABLE FOR THE DEVELOPMENT OF WELLS IN DRIFT

BY
DALE L. FULLER
AND
J. R. McMILLEN
1954



MISSOURI GEOLOGICAL SURVEY
AND WATER RESOURCES
ROLLA, MISSOURI
THOMAS R. BEVERIDGE
STATE GEOLOGIST

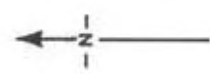
PLATE 1



Base by the Missouri State Highway Department, 1954

LEGEND

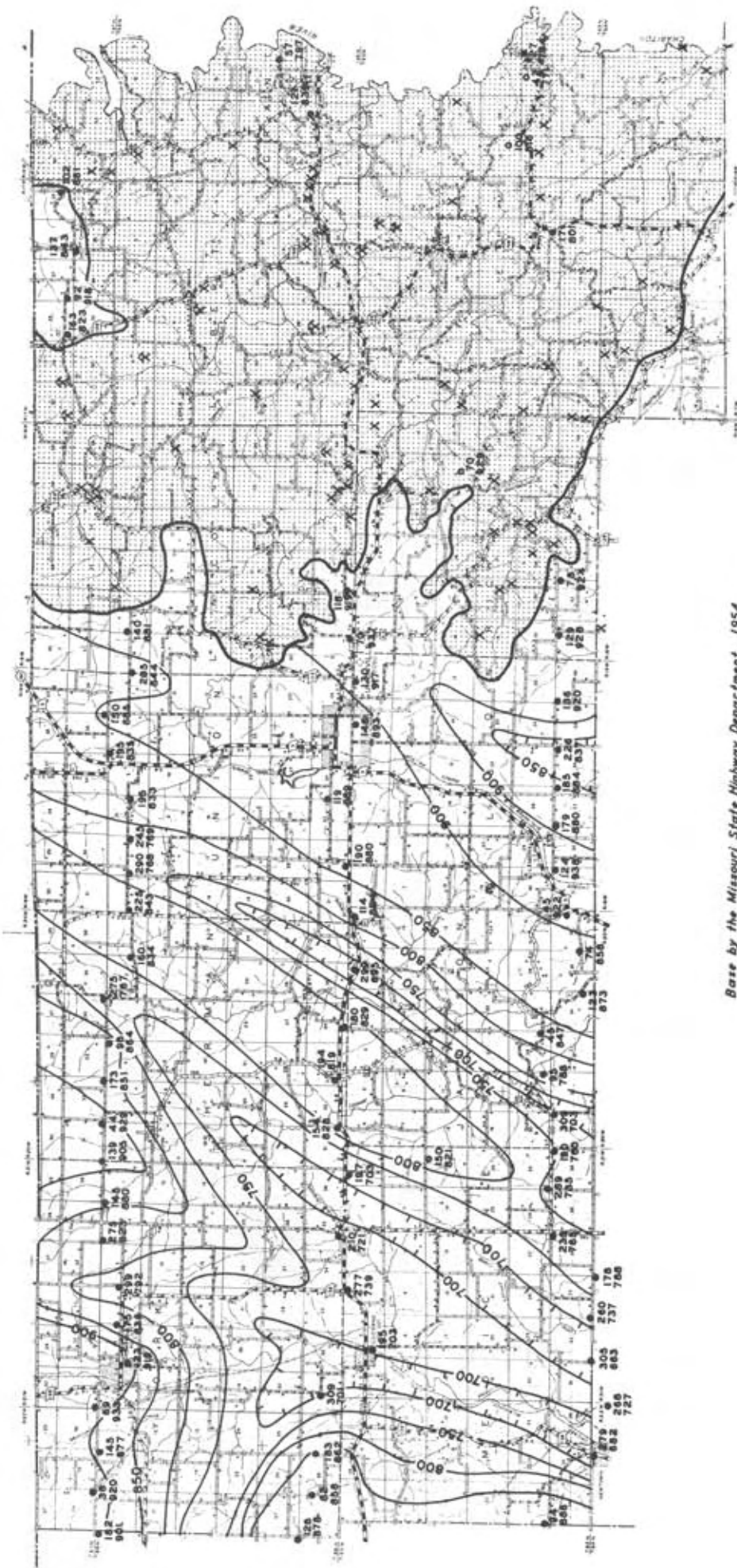
-  Drift filled valley
-  Test wells that flowed



MAP OF PUTNAM COUNTY SHOWING DRIFT FILLED VALLEYS IN WHICH IRRIGATION WELLS POSSIBLY CAN BE DEVELOPED

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1956

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THOMAS R. BENDER
STATE GEOLOGIST



Base by the Missouri State Highway Department, 1954

LEGEND

- Test holes showing thickness in feet of drift and elevation of bedrock above sea level.
- o Water wells
- x Bedrock Outcrops
- ⊗ Mine or Quarry
- ▨ General area in which bedrock is exposed at the surface

Contour interval 50 feet

CONTOUR MAP
OF
PUTNAM COUNTY
SHOWING
BEDROCK ELEVATIONS
BY
DALE L. FULLER
AND
J. R. McMULLEN
1954
MISSOURI GEOLOGICAL SURVEY
AND WATER RESOURCES
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PLATE 3

may be achieved in irrigation wells. However, it should be noted that this estimated production is based upon the yield capacity of the water-bearing sands found in the area outlined on Plate 3 rather than on the results of actual pumping tests of developed wells.

Yields to be expected are contingent upon several factors:

- (1) The thickness of the sand and gravel beds and the size and sorting of the sand particles have a direct bearing.
- (2) Re-charge rate of the water-bearing zones.
- (3) The manner of construction and materials used such as proper well screen, gravel pack, etc.
- (4) Ability of the well driller to fully develop the full capacity of the water bearing sands.
- (5) Continued successful production is contingent upon the quality of screen and materials used in the well development because it will probably be necessary to acidize and treat the well screen and water-bearing formation at a later date.

SUMMARY

Approximately 30,000 acres of Putnam County are located within the area in which irrigation wells possibly can be developed. Much of the western half of Putnam County lies in glacial drift areas where sufficient water for domestic needs is available.

Questions concerning water problems for a specific location should be sent to the Missouri Geological Survey and Water Resources, Buehler Park, Post Office Box 250, Rolla, Missouri 65401.